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The Strongest Wheat in Commerce



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**DEPARTMENT OF TRADE AND COMMERCE
OTTAWA, CANADA**

**MINISTER
Hon. R. B. HANSON, K.C., M.P.**

**DEPUTY MINISTER
JAS. G. PARMELEE**

CANADIAN WHEAT

**The Strongest
Wheat in Commerce**

Issued by the Commercial Intelligence Service
L. D. Wilgress, Director

CANADA—DEPARTMENT OF TRADE AND
COMMERCE

COMMERCIAL INTELLIGENCE SERVICE

This pamphlet deals briefly with several of the chief features of Canada's wheat export trade, and especially with those qualities of Canadian hard wheat which make it of unique value to millers, in importing countries, for blending purposes.

The material was assembled by Dr. J. G. Malloch of the National Research Council, Ottawa, who drew upon only the most reliable sources of information—notably upon the results of tests conducted at the Dominion Grain Research Laboratory, Winnipeg. In addition, striking evidence on the merits of Canadian flour has been made available as the result of studies by competent authorities in Great Britain, United States and Continental Europe.

All of the photographic illustrations were supplied through the courtesy of the Dominion Grain Research Laboratory.

Published by Authority of the Hon. R. B. Hanson, K.C., M.P.,
Minister of Trade and Commerce

Canadian Wheat

WHEAT belongs to the small and select company of major factors in world trade. It is one of the key commodities of commerce. Year in and year out the export and import of wheat accounts for a huge volume of international business. And the greatest single contribution to world wheat trade is that of Canada.

Quality and quantity unite to lend premier importance to Canadian wheat. No other country exports so heavily to the world's markets, and none produces wheat of higher quality. Hard wheat from Canada is of unsurpassed value for purposes of blending with the home-grown wheats of the importing countries. It is not an exaggeration to say that no importing country produces wheat which cannot be improved by blending with the Canadian product. That feature, more than any other, explains the fact that wheat grown on the prairies of Western Canada is known and familiar to the millers of dozens of countries, scattered all the way from Europe to the Orient and from the North to the South Seas.

In describing Manitoba (Canadian) wheat, Dr. E. A. Fisher, Director of Research, the Research Association of British Flour-Millers, says in part:—

"Typical Manitoba of high grade has been for many years the strongest wheat in commerce. Moreover, it is of excellent milling quality . . . Its moisture content is not so low as that of many imported wheats; ordinarily it may be anything between 12 and 14 per cent. In spite of this, it gives a high yield of a lively granular flour of creamy colour. The bread-making properties of this wheat owe their excellence to the fact that its protein is not only (on the average) as high in quantity as ever found commercially in any wheat, but is also of superb quality. The flour has a high water absorption and gives a dough of characteristic excellence; tough and 'rubbery' of very good spring yet very extensible and of great stability (when sufficiently fermented) . . . Properly mellowed, an all-Manitoba dough gives a magnificent loaf of gold-red crust and large face. Its crumb is very appetising—of fairly close, even grain, soft but excellent spring, pile and texture, with (when the flour is unbleached) a pale creamy colour and fine bloom."¹

Growth of the Western Canada Wheat Industry

It was not until 1877 that the first export shipment of wheat from Western Canada was made. The spanning of the prairies by the Canadian Pacific Railway in 1884 marked the beginning of a regular export business, and since that time development has attained a great scale. In the

¹ Pamphlet No. 10, Technical Education Series, The National Joint Industrial Council for the Flour Milling Industry. London.

1934 crop year Canada grew about 24,000,000 acres of wheat. The largest export in any year was in 1928-29, when over 354,000,000 bushels were exported.

Two factors have contributed greatly to this growth. First, the introduction of varieties which, under the soil and climatic conditions of Western Canada, produce the finest wheat in the world; and, second, the system of government supervision of the wheat trade which safeguards the quality and ensures that the buyer can purchase Canadian wheat with confidence.

The first task of the Experimental Farms after their establishment by the Dominion Government in 1886 was to find an early-maturing wheat of superior quality. The Red Fife wheat, then in use, matured too late to avoid the danger of frost in Western Canada. Several varieties were tried but found unsatisfactory. Even in those early days it was realized that no variety of wheat of inferior milling and baking quality could be given a permanent place in Canadian agriculture. In 1904 Dr. C. E. Saunders selected a single plant, the progeny of a cross between Red Fife and Hard Red Calcutta. The seed from this plant was multiplied, and in 1907 milling and baking tests showed that its quality excelled that of Red Fife. The new variety, named Marquis, proved to be so superior in quality and yield that its cultivation rapidly became widespread. To-day, about 80 per cent of all wheat grown in Western Canada is Marquis.

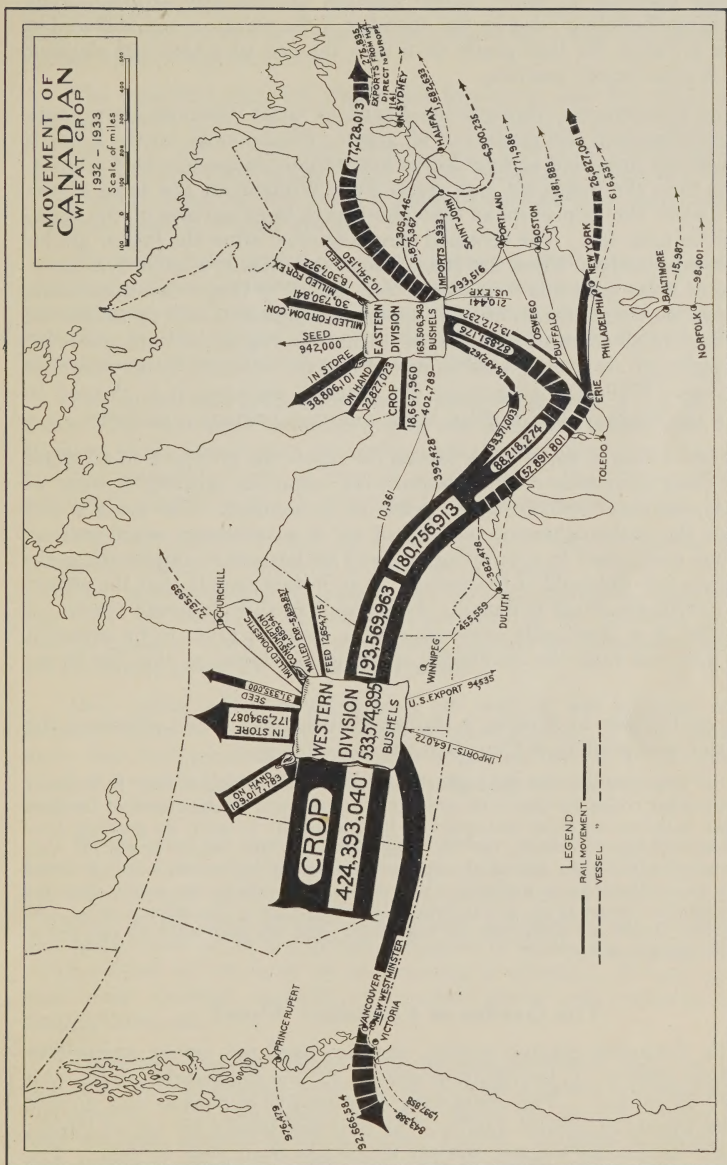
The search for new and better varieties still goes on. Recently the Dominion Experimental Farms have originated a variety, named Reward, which has even better baking quality than Marquis and, on account of its earliness, is specially suited to the northern portions of Canada's wheat-growing area.

From the inception of Western Canada's wheat export trade, the protection of the buyer by a rigid system of inspection and grading has been regarded as essential. Various earlier measures for that purpose led up to the passage, in 1912, of the Canada Grain Act. This act has been amended from time to time to correct abuses and to ensure that the high standards set for Canadian wheat are preserved. In addition to the inspection and grading services, elaborate facilities for the bulk handling of grain have been provided, and it may fairly be said that no country in the world has a finer system of grain merchandising, or affords more adequate protection for the wheat buyer, than Canada.

Canada's Grain Inspection System

Canada has the largest exportable surplus of all wheat-producing countries. The moving of the crop from the inland prairie farms to the holds of vessels on the seaboard is an immense task. To cope with it, a system has been evolved which is exceptional in speed, in efficiency, and in the care taken to protect the buyers' interests.

Wheat from the farms is generally delivered in bulk to elevators on the nearest railroad. Commercial grain in Canada is never sacked but is always handled in bulk by machinery. The typical country elevator has



The map illustrates the manner in which the export movement of Western Canada wheat is divided, first, into two main streams—one flowing to the east, the other to the west. The westward movement to Vancouver has become very heavy in quite recent years. The major movement is still eastward to the head of the Great Lakes, thence to St. Lawrence and Atlantic ports, with Montreal as the chief outlet. The third seaboard movement, north-easterly to Churchill on Hudson Bay, is as yet small.

a storage capacity of about 30,000 bushels, divided into 16 bins. The wheat is unofficially graded by the operator of the elevator, and is stored in the bin set aside for that grade until it is shipped to a terminal elevator where it is in export position.

The Government, through the Board of Grain Commissioners, controls the inspection and grading of all grain. For example, on the Eastern route cars are inspected and graded by government inspectors at Winnipeg. By the time the inspected cars reach Fort William, at the head of the Great Lakes, the inspectors at that point have been advised of the grade of grain in each car. The terminal elevators must store the higher grades of grain separately. These are No. 1 Hard, and Nos. 1, 2 and 3 Northern. Mixing of these grades is forbidden. The Board of Grain Commissioners, by a system of registration of all receipts and shipments and by an annual weigh-over of all terminal elevators, sees that the regulations are observed. The weights of all grain loaded in or out are also checked by government employees. While the grain is in the terminal elevators it is cleaned to remove the dockage, and is dried if the moisture content is excessive.

When a boat or car is being loaded for export the process is at all times under strict government supervision. An inspector receives a copy of the shipping order specifying the grade to be shipped. The grain is run through the scales where it is weighed by a government weigh-master. It is then discharged to a shipping bin, and an inspector samples the grain as it drops into the hold of the vessel. It is on this sample that the official grade Certificate Final is issued. As a result of this elaborate system of inspection, it is practically impossible for a cargo of grain to be exported which does not fulfil the conditions of the grade stated on the Certificate Final.

A contributor to *Milling*, a leading British trade paper, discusses the inspection and grading of Canadian wheat as follows:¹

"It says much for the high character of the grading system in Canada that other countries desire to emulate it; and much to the credit of Canada that it leaves no stone unturned in its endeavour to keep its grading constant. It goes further, for no suggestion for the improvement of this already world-wide accepted supreme system is left unexplored, so keen are the authorities to maintain their exalted position in the world of grain. Reliability in the truth of the principles of grading is the miller's safeguard against fraud, his authority for regularity, and his guarantee to the baker for baking quality."

The Grades of Canadian Wheat

The Canadian grading system classifies hard red spring wheat into three main groups, (1) the statutory grades, (2) the commercial grades, and (3) the "off grades." The statutory grades are five in number and include only the wheats of highest quality. As they are defined by Act of Parliament the definitions are not subject to change from year to year. The

¹ *Milling*, June 21, 1930.

minimum requirements for the admission of wheat into the statutory grades are summarized in the accompanying table. The requirements for export wheat are much stricter.

The standard samples which the inspectors use for references in grading export grain must consist of 75 per cent of grain equal to the average of the grade, with only 25 per cent of grain equal to the minimum of the grade as defined in the table. Thus, before any wheat can be given a Certificate Final for any grade it must be substantially better than the minimum quality of that grade.

The commercial grades comprise wheats not eligible for the statutory grades and their characteristics may vary annually depending upon the prevailing types of damage, such as rusted, frosted, immature and sprouted kernels. As they are not defined in the Act, their inclusion in the grading system provides a certain degree of flexibility.

The commercial grades are three in number, namely, No. 5, No. 6 and Feed. The standards for these grades are established each year by the Western Grain Standards Committee after the crop movement has begun and the prevailing types of damage ascertained. The system of export standards, outlined above, is also used for the commercial grades.

The "off grades" include all wheat which for various reasons cannot be classed within the statutory or commercial grades. Wheat in this class comprises grain damaged by heating, bin burning, mustiness, smut, sprouting, etc. All wheats so damaged are assigned to the statutory or commercial grade to which they would belong if sound and a notation made on the certificate giving the reason for rejection.

Only wheat which contains 14.5 per cent or less moisture can be included in any of the statutory or commercial grades. Wheat containing more than that percentage of moisture is graded "tough" of the grade to which it would belong if dry. Wheat containing over 17 per cent moisture is dried before export.

Wheat must be commercially clean before it can be granted a Certificate Final. Dockage includes all weed seeds, dirt, sand, chaff, straw, or any other foreign matter which can be removed readily from the grain by the use of proper sieves and cleaning devices; it includes, also, the shrunken and small pieces of broken kernels, removed in separating foreign matter, which cannot be recovered by re-screening or cleaning. Foreign matter, apart from dockage, includes other cereal grains and ragweed, cockle, darnel, vetch, etc.

The wheat must be cleaned at the terminal elevators, and if on inspection it is found to contain 1 per cent of dockage a clear Certificate Final is not granted. The accompanying table shows the foreign matter, other than dockage, allowed in the statutory grades. It must be remembered that these are maximum limits and that, generally, export grain contains considerably less than the maximum.

STATUTORY GRADES OF WESTERN CANADA GRAIN

RED SPRING WHEAT

Number and Name of Grade	Minimum Weight per Bushel in Pounds	Variety of Grain	Percentage by Weight of Hard Vitreous Kernels %	Standard of Quality	Maximum Limits of:—			
					Foreign Material other than Dockage		Wheats of other Classes	
					Matter other than Cereal Grains	Total including Cereal Grains %	Durum %	Total including Durum %
No. 1 Manitoba Hard.	62	Marquis or equal to Marquis.	80	Sound and well ma- tured.	Free.....	Free.....	.....	.....
No. 1 Manitoba Nor- thern.	60	Marquis or equal to Marquis.	65	Well matured, prac- tically free from damaged kernels.	Free.....	Practically free.....	Practically free.	1
No. 2 Manitoba Nor- thern.	58	Red Spring Wheat of good milling quality.	50	Reasonably well matured, reason- ably free from damaged kernels.	Free.....	About 1%.....	1	3
No. 3 Manitoba Nor- thern.	57	Red Spring Wheat of fair milling quality.	25	Reasonably well matured, reason- ably free from damaged kernels.	Reasonably free.....	About 2%.....	3	10
No. 4 Manitoba Nor- thern.	57	Red Spring Wheat.	.....	Reasonably well matured, but ex- cluded from pre- ceding grades on account of frosted or otherwise dam- aged kernels.	Reasonably free.....	About 2½%.....	4	10
or	55	Red Spring Wheat.	.....	Rusted or shrunken but otherwise reasonably sound.	Reasonably free.....	About 2½%.....	4	10

Every possible safeguard is used to ensure that the Canadian Certificate Final accurately describes the grain for which it is issued, and the authorities are always glad to receive suggestions leading to the maintenance of the high reputation of the Canadian system of grading. With such a system in force the buyer can be confident of obtaining the kind of Canadian wheat he desires to raise the quality of his blend.

Flour from Canadian Wheat

(1) ABSORPTION AND BREAD YIELD

While there is endless variation in the kinds of flour suited to different trades, there is one quality in flour which every baker wants—the capacity for high absorption of water and the resultant high yield of bread. The miller who uses a high proportion of Canadian wheats in his blends is able to satisfy the baker's demand for a large number of loaves from a barrel of flour. The higher Manitoba grades are unexcelled in their ability to raise the absorption and the bread yield of the flour from any blend.

Even the countries selling wheat of competing sorts admit the superiority of Canadian wheat in this respect. The following table was compiled from data collected by the United States Department of Agriculture.¹ The absorption is expressed as the percentage which the weight of water added bears to the weight of the flour.

	Absorption, Per Cent	Yield of Bread per Barrel (196 pounds)
Canadian 1 Manitoba.....	59.6	292
2 Manitoba.....	59.4	293
3 Manitoba.....	59.9	292
4 Manitoba.....	62.4	294
Average (all grades).....	60.9	293
Argentine.....	56.1	285
Australian.....	54.8	286
English.....	52.6	285
German.....	53.2	283
Italian.....	53.0	285
Russian (hard wheats).....	57.1	289
United States hard red spring.....	58.2	289
Hard red winter.....	57.9	289

As these figures show, flour from Canadian wheat absorbs more water and gives a higher yield of bread than the flour milled from other wheats. It is true that these figures are for unblended products, but Canadian wheat will increase the water absorption and hence the bread yield of a blend. The following tables prepared from data obtained in the Dominion Grain Research Laboratory, Winnipeg, Canada, illustrate this point:—

¹ U. S. Department of Agriculture, Technical Bulletin No. 197.

FLOUR BLENDS

Canadian, Per Cent	German, Per Cent	Absorption, Per Cent
100	—	64.7
—	100	59.0
15	85	59.8
25	75	60.3
40	60	61.3
Canadian, Per Cent	French, Per Cent	
100	—	64.7
—	100	58.0
15	85	59.0
25	75	59.6
40	60	60.7
Canadian, Per Cent	Argentine, Per Cent	
100	—	65.0
—	100	62.8
25	75	63.3
50	50	63.9

A similar study was made in the Cereal Laboratories of the University of Saskatchewan, Canada, using Australian and English wheats, and the results are given below:—

Canadian, Per Cent	Australian, Per Cent	Absorption, Per Cent
100	—	66
—	100	61
20	80	62
60	40	64
Canadian, Per Cent	English, Per Cent	Absorption, Per Cent
100	—	66
—	100	57
20	80	61
60	40	65

It can be readily seen that the use of Canadian wheat, in blends, gives flour which enables the baker to incorporate more water in his doughs.

In the issue of *Milling* dated November 5, 1932, Mr. W. S. Thompson gives a classification of wheats on the basis of bread yield. He has arranged the different types in order of merit, dividing them into three classes. His classification is as follows:—

Good	Medium	Poor
Manitoba (Canadian)	Barusso (Argentine)	Yeoman I and II (Eng.)
Northern Spring (U.S.)	Australian	Danubian
Karachi (Indian)	Baril (Argentine)	Red Winter (U.S.)
Persian	Durum	White Pacific (U.S.)
Hard Winter (U.S.)	Rosafe (Argentine)	German
	Russian	Red English
		French
		White English

In the same way that the high absorption of Canadian wheat is communicated to a blend, the bread yield of any flour can be improved by the inclusion of Canadian wheat in the grist.

Some years ago information on this point, obtained by the State Institute of Baking Research, Berlin, was published. The units in which the bread yield was expressed were not given but the figures are comparable, and are the averages of three separate tests.

BLEND

German	Manitoba	Bread Yield
Per Cent	Per Cent	
100	—	137
—	100	141
70	30	139
50	50	141

In these tests the use of 50 per cent of Canadian wheat was sufficient to bring the bread yield of the blend up to the yield of all-Canadian wheat.

2. DOUGH QUALITY

QUANTITY AND QUALITY OF GLUTEN

As no one has yet been able to measure all of the properties of dough with precision, the terms employed to describe dough are used very loosely. It is known, however, that for a dough to be satisfactory to a baker it must be able to retain the gas that is generated within it; it must be able to keep its shape or, as some say, have "stability"; it must be easy to handle; and it should be able to stand prolonged fermentation when necessary.

Canadian wheat gives flour which has all these qualities to a high degree, and, moreover, they will be imparted to blends in proportion to the amount of Canadian wheat used. All these properties are related to the quantity and quality of the gluten or protein which combines with the other dough constituents to form the elastic films that retain the gas. The rich soil and the hot dry climate of the Canadian West are ideal for the production of high-quality gluten. In the higher grades of wheat this quality is at its best; in the lower grades, which contain varying percentages of damaged kernels, the quality is naturally reduced.

As the quality of the gluten in Canadian wheat is excellent, further comparison may be made with other sorts of wheat on the basis of quantity of protein. Such a comparison will minimize rather than accentuate the superiority of Canadian wheat. The following table gives the mean protein content of the first four grades of Western Canadian hard red spring wheat for the crop years 1929 to 1934 inclusive:

Wheat	1929	1930	1931	1932	1933	1934
	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
1 Manitoba Hard.....	13.7	14.2	14.6	14.3	14.4	14.5
1 Manitoba Northern.....	13.7	13.8	14.4	14.3	14.2	14.4
2 Manitoba Northern.....	13.2	12.5	13.2	13.4	13.4	13.7
3 Manitoba Northern.....	12.9	12.4	13.0	14.0	13.8	13.7

The protein content of wheats of other countries for 1929—the last year for which a complete set of data is available—as determined by the U.S. Department of Agriculture,¹ was: Argentinian, 11.4 per cent; Australian, 10.3; English, 9.6; German, 10.2; Indian, 13.9; Italian, 11.2; Russian, 13; United States, 12.8; United States hard red spring, 12.8; and United States hard red winter, 12 per cent.

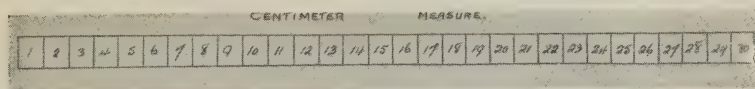
Dr. D. W. Kent-Jones, Chief Chemist of Woodland's Ltd., millers, Dover, England, reports a series of tests of gluten percentages, with remarks on the quality. The following is condensed from his table:—

Wheat	Gluten	Remarks
	Per Cent	
Manitoba 1.....	13.3	Very good
Manitoba 2.....	13.0	Very good
Manitoba 3.....	13.2	Very good indeed
English.....	6.2	Quite good elasticity and standing power
Australian.....	9.0	Fair to good
Rosafe Plate.....	10.5	Quite good
Red English.....	7.4	Poor quality, ran flat
White Karachi.....	10.3	Good
Northern Spring.....	12.5	Good
Manchurian.....	12.7	Only fair

The remarks indicate, in a general way, the relative merit of the glutes from different wheats. While it is evident that Canadian wheat excels the others listed, the terms used do not fully disclose its excellence. The Dominion Grain Research Laboratory, Winnipeg, recently completed a series of tests of gluten quality, and the results have been recorded by means of photographs. The extensibility, stability and expansion of the gluten from No. 1 Manitoba wheat, compared with that of a typical European soft wheat, and the improvement in the latter by blending with the Canadian product, are well illustrated in the accompanying cuts.

¹ U.S. Department of Agriculture, Technical Bulletin No. 197.

PLATE 1.—Comparative Extensibility of the Gluten from Canadian and a Typical European Soft Flour



100% Manitoba One Northern Flour

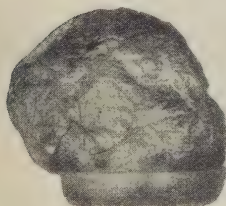


75% Typical European Soft Flour
25% Manitoba One Northern Flour

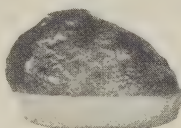


100% Typical European Soft Flour

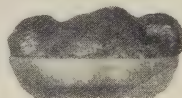
PLATE 2.—Comparative Stability and Expansion on Baking of the Glutens from Canadian and a Typical European Soft Flour



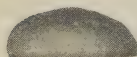
100% Manitoba One Northern Flour



75% Typical European Soft Flour
25% Manitoba One Northern Flour



100% Typical European Soft Flour



100% Manitoba One Northern Flour



75% Typical European Soft Flour
25% Manitoba One Northern Flour



100% Typical European Soft Flour

These photographs illustrate the superior quality of the gluten from Canadian wheat, and the improvement that can be effected by blending weaker wheats with Canadian.

3. DOUGH QUALITY

GAS RETENTION AND FERMENTATION TOLERANCE

Owing to the abundant amount of good quality gluten, the flour made from Canadian wheat yields an excellent dough which is easy to handle, retains gas well, and exhibits these qualities over long periods of fermentation. These qualities can be conferred on blends by the inclusion of Canadian wheat. The excellent gas-retaining power, and the consequent great expansion of the dough made from Manitoba wheat flour, are further shown in the following table and photographs which give the results of experiments conducted by the Dominion Grain Research Laboratory:—

Wheat	Maximum Height of Dough (Centimetres)	Time Dough Remained at Maximum Height (Minutes)
Manitoba.....	425	40
German.....	335	15
English.....	310	10
French.....	320	10
Italian.....	320	15
Australian.....	355	20
25% Manitoba, 75% Italian.....	350	20

The dough from Canadian wheat not only rises more, but it retains its maximum height for twice as long as that from any of the other flours studied. This quality is of great importance since it means that the baker can produce good bread over a wide range of fermentation times. The improvement from the blending of 25 per cent Manitoba with the Italian flour should be noted—there was a 10 per cent increase in volume and a 33 per cent increase in the time this volume was maintained. The photographs which follow show the doughs used in these experiments.

PLATE 3.—Comparative Dough Expansion of Canadian and Soft Wheat Flours

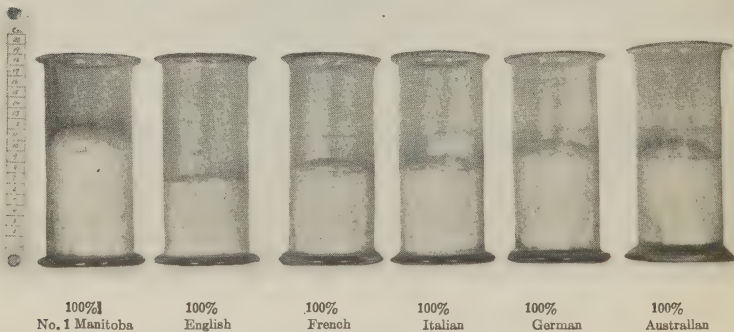
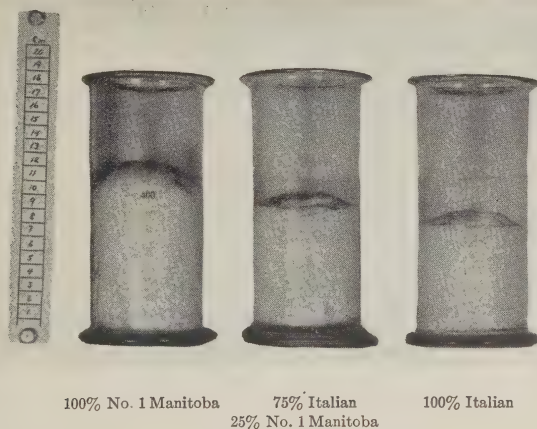


PLATE 4.—Comparative Dough Expansion of Canadian and Italian Flour, and of a Blend of Same



100% No. 1 Manitoba

75% Italian
25% No. 1 Manitoba

100% Italian

The ability to stand prolonged fermentation is one of the chief qualities of Manitoba wheat flour. The marked preference for flour from Canadian wheats, shown by bakers in Scotland, where long fermentation periods are customary, is practical evidence of the superiority of Canadian wheat in this respect.

The results, already cited, are confirmed by investigations carried out in Germany. The following table compiled from experiments conducted by Dr. W. Litzendorff of the Georg Plange Co., millers, of Dusseldorf, using Manitoba No. 4, shows the improvement that can be obtained even by the use of a lower grade of Canadian wheat.

Flour	Working of Dough	Height of Dough in Cylinder
HIGHEST GRADE		
100% German.....	Short, moist.....	184
50% German, 50% Manitoba 4.....	Good, comparatively moist.....	199
SECOND GRADE		
100 % German.....	Weak, moist.....	145
50% German, 50% Manitoba 4.....	Good, comparatively moist.....	165

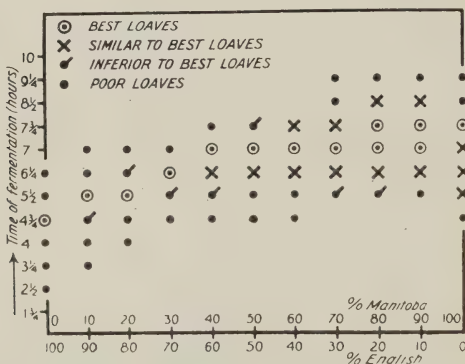
There was a marked improvement in the handling qualities and in the expansion of the dough from the 50 per cent blend as compared with that of the 100 per cent German.

To take full advantage of the high gas-retaining power which Canadian wheat confers on blends, it is desirable that a free-gassing wheat should be

included in the grist. Manitoba wheats of grades 4 and 5 are relatively good gassers, and they can be used to supplement the gas production of the higher grades. The ability of the dough from Canadian wheat flour to retain its maximum volume over long periods is an indication of the wide range of fermentation periods over which good bread can be produced from flour containing high percentages of Canadian wheat. This feature of flour milled from Canadian wheat is shown in the results of experiments reported¹ by Dr. E. A. Fisher, Director of Research, the Research Association of British Flour Millers.

Dr. Fisher baked a series of loaves from flours made from English and Manitoba (Canadian) wheats and from blends of the two, using varying periods of fermentation with each blend. The all-English flour gave only one "best" loaf (at $4\frac{3}{4}$ hours fermentation); the all-Manitoba (Canadian) gave satisfactory loaves when fermented for any period from $5\frac{1}{2}$ to $7\frac{3}{4}$ hours, and these loaves were larger, better risen, and more appetizing than the English. It should be noted that in these experiments only 1 per cent of yeast was used. Where more yeast or improvers, such as arkady or malt extract, are used, the time necessary to produce good loaves from flours with high percentages of Manitobas could be substantially reduced. The full results of the experiment are shown graphically below:—

PLATE 5.—Baking Quality of Manitoba-English Blends



In discussing these results Dr. Fisher says:—

"Obviously a flour with a wide fermentation tolerance will 'stand up' better to a variety of treatments than would a weak flour of restricted tolerance. The fermentation tolerance increased with increasing content of Manitoba, slowly at first, then more rapidly . . . A strong flour which produces good bread over a long period is obviously more fool-proof, requires less care and attention during fermentation, is less likely to go wrong in the event of accident or inadvertence, and is consequently worth more to the baker than a weaker flour."

¹ *Journal of the Society of Chemical Industry*, August 4, 1933.

4. DOUGH QUALITY

STABILITY

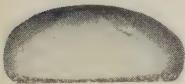
The stability of dough, or its ability to rise instead of flattening out, is closely related to the gas-retaining capacity. In *Milling* for November 5, 1932, Mr. W. S. Thompson gives a classification of the wheats of the world on the basis of the ability of flours milled from them to give stable doughs. The wheats are placed in three classes, and in order of merit within each class.

<i>Good</i>	<i>Medium</i>	<i>Poor</i>
Karachi (Indian)	Baril (Argentine)	Danubian
Persian	Durum	Yeoman I and II (English)
Canadian	Russian	Red Winter (U.S.)
Northern Spring (U.S.)	Rosafe (Argentine)	White Pacific (U.S.)
Australian	Hard Pacific (U.S.)	Red English
Hard Winter (U.S.)		White English
Barusso (Argentine)		

Canadian wheat stands almost at the top of the list, and is actually the leader among those wheats that enter most heavily and prominently into world wheat trade.

The Dominion Grain Research Laboratory recently completed tests of the stability of the flours made from a series of different wheats. The results are illustrated in the following plates:—

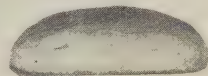
PLATE 6.—Doughs from Canadian and Typical Soft Wheat Flours, after Normal Fermentation and allowing to stand for One Hour



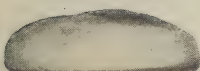
100% No. 1 Manitoba



100% English



100% French



100% Italian



100% German



100% Australian

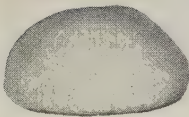
PLATE 7.—Doughs from Flour of Blended Canadian and Soft Wheats, after Normal Fermentation and allowing to stand for One Hour



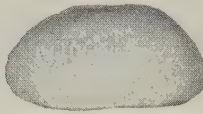
100% No. 1 Manitoba



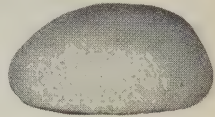
100% Italian



85% Italian
15% No. 1 Manitoba



75% Italian
25% No. 1 Manitoba

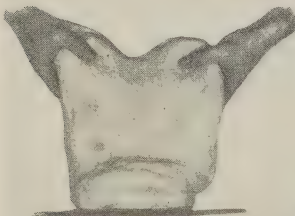


60% Italian
40% No. 1 Manitoba

The second plate shows very strikingly the beneficial effect of blending even small percentages of Canadian wheat with soft wheats.

Dough must have a certain "toughness" to handle well in the bakery, particularly when machinery is used. The following photograph contrasts an easily-worked dough from Canadian wheat flour with a typical "runny" dough made from European soft wheat flour, and indicates the improvement brought about by blending this wheat with 25 per cent of Canadian wheat.

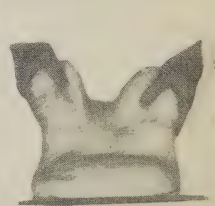
PLATE 8.—Doughs from Canadian and a Typical European Soft Flour, after Normal Fermentation



100% Manitoba One Northern Flour



75% Typical European Soft Flour
25% Manitoba One Northern Flour



100% Typical European Soft Flour

The inclusion of Canadian wheat in a blend results in marked improvement in the stability and general quality of the dough.

5. BAKING QUALITY (a)

The baker demands that the flour he buys shall produce bread of good quality, suited to the trade he serves. All other flour properties are subordinate to this main requirement. The combination of flour characteristics which makes possible the baking of high-quality bread is sometimes described by the general term "strength", although this term is also used in other senses.

Strength is the outstanding feature of Canadian wheat. The high absorption, high percentage of good quality gluten, and the desirable dough characteristics of the flour it yields—all contribute to its ability to "carry" weaker wheats with which it may be blended, and to ensure the production of first-class loaves from the resulting flour. When Canadian flour is used alone it is sometimes necessary for the baker to add stimulants to gas production, to take advantage of the full strength of the flour. In commercial blends containing European soft wheats gas production is usually adequate, and Canadian wheat here gives its best service in carrying and improving the weaker wheats with which it may be mixed. The lower-grade Manitobas are very useful for increasing the gassing power of a blend.

The following is Mr. W. S. Thompson's classification of wheats¹ on the basis of strength. As in the lists previously given, the wheats are divided into three classes and are listed in order of merit within each class.

<i>Good</i>	<i>Medium</i>	<i>Poor</i>
Manitoba	Persian	Red Winter
Northern Spring.	Karachi	Danubian
Russian	Baril	White Pacific
Hard Winter	Australian	German
Barusso	Hard Pacific	Red English
	Durum	White English
	Yeoman I and II	French
	Rosafe	

Dr. D. W. Kent-Jones, Chief Chemist of Woodland's Ltd., Dover, England, in his "Modern Cereal Chemistry" gives strength figures for the more important classes of wheat. These are tabulated below:—

Wheat	Strength Figure	Wheat	Strength Figure
Manitoba.....	66-76	Australian.....	about 50
Northern Spring.....	60-66	Bombay.....	about 40
Hard Winter.....	55-57	Karachi.....	about 40
Red Winter.....	32-37	Persian.....	47-62
Pacifics.....	18-30	Manchurian.....	about 58
Rosafe.....	32-58	Red English.....	24-28
Barusso.....	about 50	White English.....	19-23
Baril }		Yeoman.....	38-40

¹ *Milling*, November 5, 1932.

Dr. E. A. Fisher, after discussing the improved fermentation tolerance obtained by blending Manitoba (Canadian) wheat with English wheat, says:—

“The strong flour also gives the larger better-risen loaf because the gluten network is better able to hold the gas liberated during the final stage of fermentation and expanded during the first few minutes in the oven. The outside appearance of the loaf is altogether more handsome and the loaf more saleable in consequence. Its crumb is much better developed; it is softer, more elastic, has greater power of recovery if ‘thumbed’ and its grain, or vesiculation of the crumb, is more attractive. In short, it is more appetizing.”¹

With its very high strength, as indicated by the above classifications, Canadian wheat must have the ability to “carry” weaker wheats in a blend. This is borne out by experience. It has been found in practice and by experiment that the use of Canadian wheat in blends will greatly increase the size of the loaf obtained from the flour, without in any way impairing the texture and other qualities of the loaf. The following figures were obtained in this connection by Professor M. P. Neumann, of Berlin:—

Blend		Loaf Volume	Texture	Baking No.
		Cubic Centimetres of Bread produced from 400 grams of flour		
Canadian Per Cent	German Per Cent			
PATENT FLOUR				
100	.....	1091	8	130
.....	100	698	8	.....
20	80	997	7-8	105
30	70	1022	8	114
40	60	1027	8	116
50	50	1096	8-9	132
BAKER'S FLOUR				
100	.....	1079	8-9	134
.....	100	830	8	38
20	80	969	8	101
30	70	1004	7-8	104
40	60	1029	8	131
50	50	1125	7-8	128
SPONGE DOUGH METHOD				
100	.....	909	8	86
.....	100	845	8	44
30	70	889	7-8	64
50	50	894	8	67

¹ *Journal of the Society of Chemical Industry*, Aug. 4, 1933.

The results of Professor Neumann's experiment show clearly the beneficial effect of blending Canadian flour with a weaker flour. The size of the loaf is increased, roughly in proportion to the percentage of Canadian flour in the blend. This increase in size is brought about without any loss in the other loaf qualities. The general baking quality, as indicated by the "baking number", shows substantial improvement.

6. BAKING QUALITY (b)

Three eminent British authorities have been quoted to indicate the high regard in which the baking quality of flour milled from Canadian wheat is held. The results of an experiment conducted by one of the outstanding cereal chemists of Germany have also been given to show that the flour from weaker wheats may be materially improved by blending with Manitobas. The following paragraphs, presenting results obtained by the Dominion Grain Research Laboratory, Winnipeg, emphasize the fact that the beneficial effect of blending Canadian wheat holds true with a wide range of other wheats.

PLATE 9



100% No. 1 Manitoba
Loaf Volume 2940 cc.

100% German
Loaf Volume 2060 cc.

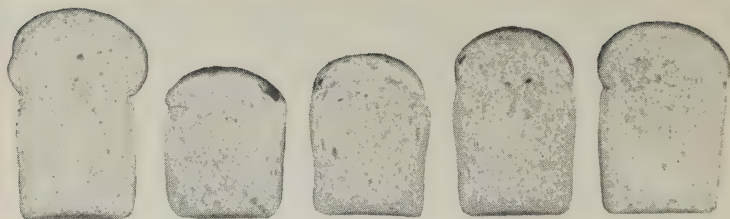
85% German
15% No. 1 Manitoba
Loaf Volume 2350 cc.

75% German
25% No. 1 Manitoba
Loaf Volume 2590 cc.

60% German
40% No. 1 Manitoba
Loaf Volume 2800 cc.

Flour Blends		Absorption	Loaf Volume		Texture	Crumb Colour	Exterior Appearance	General Baking Quality
Canadian	German							
Per Cent	Per Cent	Per Cent	Cu. Cm.	Per Cent				
100	.....	64.7	2940	.....	Good	Cream	Very good	Excellent
.....	100	59.0	2060	100	Good	Cream yellow	Fair	Fair
15	85	59.8	2350	114	Good	Cream yellow	Fairly good	Fairly good
25	75	60.3	2590	126	Good	Cream yellow	Good	Good
40	60	61.3	2800	136	Good	Cream	Good	Very good

PLATE 10



100% No. 1 Manitoba
Loaf Volume 2940 cc.

100% English
Loaf Volume 1840 cc.

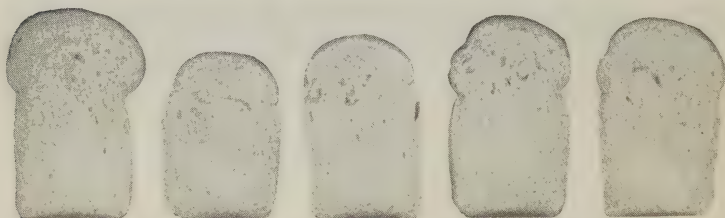
85% English
15% No. 1 Manitoba
Loaf Volume 2130 cc.

75% English
25% No. 1 Manitoba
Loaf Volume 2430 cc.

60% English
40% No. 1 Manitoba
Loaf Volume 2650 cc.

Flour Blends		Absorption	Loaf Volume		Texture	Crumb Colour	Exterior Appearance	General Baking Quality
Canadian	English							
Per Cent	Per Cent	Per Cent	Cu. Cm.	Per Cent				
100	100	64.7	2940	100	Good	Cream	Very good	Excellent
.....	100	58.2	1840	.....	Good	Dull cream yellow	Very poor	Very poor
15	85	59.2	2130	116	Good	Dull cream yellow	Poor	Fair
25	75	59.8	2430	132	Good	Cream yellow	Fairly good	Fairly good
40	60	60.8	2650	144	Good	Cream yellow	Good	Good

PLATE 11



100% No. 1 Manitoba
Loaf Volume 2940 cc.

100% French
Loaf Volume 2070 cc.

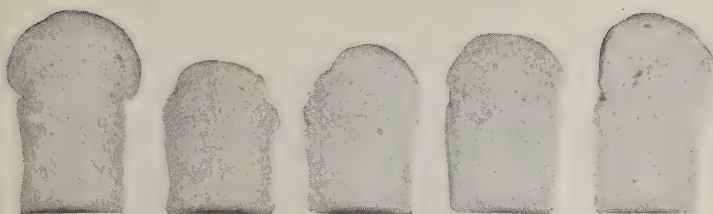
85% French
15% No. 1 Manitoba
Loaf Volume 2300 cc.

75% French
25% No. 1 Manitoba
Loaf Volume 2570 cc.

60% French
40% No. 1 Manitoba
Loaf Volume 2760 cc.

Flour Blends		Absorption	Loaf Volume		Texture	Crumb Colour	Exterior Appearance	General Baking Quality
Canadian	French							
Per Cent	Per Cent	Per Cent	Cu. Cm.	Per Cent				
100	100	64.7	2940	100	Good	Cream	Very good	Excellent
.....	100	58.0	2070	.....	Good	Slightly yellow	Fair	Fair
15	85	59.0	2300	111	Good	Slightly yellow	Fair	Fairly good
25	75	59.6	2570	124	Good	Cream yellow	Fairly good	Good
40	60	60.7	2760	133	Good	Cream yellow	Good	Good

PLATE 12



100% No. 1 Manitoba
Loaf Volume 2940 cc.

100% Italian
Loaf Volume 2000 cc.

85% Italian
15% No. 1 Manitoba
Loaf Volume 2280 cc.

75% Italian
25% No. 1 Manitoba
Loaf Volume 2500 cc.

60% Italian
40% No. 1 Manitoba
Loaf Volume 2610 cc.

Flour Blends		Absorption	Loaf Volume		Texture	Crumb Colour	Exterior Appearance	General Baking Quality
Canadian	Italian							
Per Cent	Per Cent	Per Cent	Cu. Cm.	Per Cent				
100	.....	64.7	2940	.....	Good	Cream	Very good	Excellent
.....	100	58.5	2000	100	Good	Slightly yellow	Poor	Poor
15	85	59.4	2280	114	Good	Slightly yellow	Fair	Fair
25	75	60.0	2500	125	Good	Cream yellow	Fairly good	Fairly good
40	60	61.0	2610	131	Good	Cream yellow	Good	Good

PLATE 13



100% No. 1 Manitoba
Loaf Volume 2940 cc.

100% Australian
Loaf Volume 2450 cc.

85% Australian
15% No. 1 Manitoba
Loaf Volume 2600 cc.

75% Australian
25% No. 1 Manitoba
Loaf Volume 2690 cc.

60% Australian
40% No. 1 Manitoba
Loaf Volume 2800 cc.

Flour Blends		Absorption	Loaf Volume		Texture	Crumb Colour	Exterior Appearance	General Baking Quality
Canadian	Australian							
Per Cent	Per Cent	Per Cent	Cu. Cm.	Per Cent				
100	.....	64.7	2940	.....	Good	Cream	Very good	Excellent
.....	100	60.1	2450	100	Good	Cream yellow	Fairly good	Fairly good
15	85	60.8	2600	106	Good	Cream yellow	Good	Good
25	75	61.2	2690	110	Good	Cream yellow	Good	Good
40	60	61.9	2800	114	Good	Cream	Very good	Very good

The results given below for the blending of Canadian and Argentine wheats are the averages of twelve tests—four flours baked by three different methods.

Flour Blends		Loaf Volume	Texture	Dough Quality	Baking Quality
Canadian	Argentine				
Per cent	Per Cent	Cu. Cm.			
100	.....	2833	Good—excellent..	Lively and very springy	Very good—excellent
.....	100	2489	Good.....	Lively and fairly springy	Fairly good
25	75	2607	Good.....	Lively and springy.	Good
50	50	2709	Good.....	Lively and springy.	Good—very good

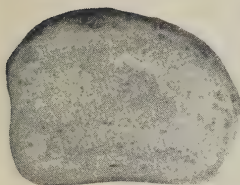
It is easily seen that blending with Canadian wheat gave better results than the use of other wheats alone. In all cases there were marked increases in the volume of the loaves produced by the blended flours. Even the relatively strong Australian was improved by as much as 16 per cent. In no case was there any loss in the other loaf qualities. The texture remained about the same and there was marked improvement in the external appearance of the loaves baked from some of the flours. Similar results can be obtained when Canadian wheat is blended with any weaker wheat.

Pan loaves were used in all these experiments but similar improvement is obtained with hearth-baked loaves. The results of experiments, using hearth-baked loaves, are presented in succeeding pages.

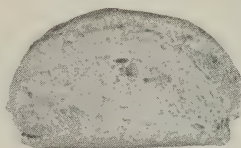
7. BAKING QUALITY (c)

The results of experiments conducted by the Dominion Grain Research Laboratory, using hearth-baked loaves, are shown photographically. They prove beyond question the superiority of Canadian wheat under this exacting test of baking quality.

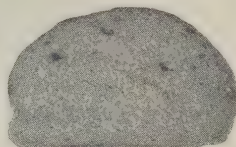
PLATE 14.—Loaves from Canadian and Other Wheat Flours (Unblended)



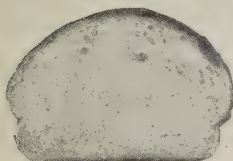
100% No. 1 Manitoba
Loaf Volume 3000 cc.



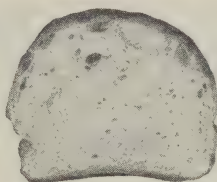
100% English
Loaf Volume 1830 cc.



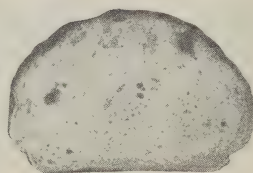
100% French
Loaf Volume 1830 cc.



100% Italian
Loaf Volume 1880 cc.



100% German
Loaf Volume 1930 cc.
FRONT VIEW

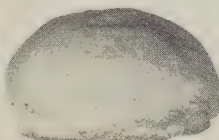


100% Australian
Loaf Volume 2180 c.c.

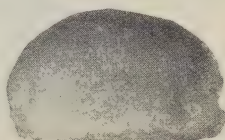
PLATE 15.—Loaves from Canadian and Other Wheat Flours (Unblended)



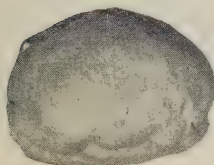
100% No. 1 Manitoba
Loaf Volume 3000 cc.



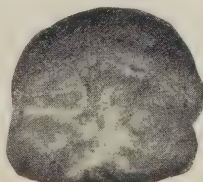
100% English
Loaf Volume 1830 cc.



100% French
Loaf Volume 1830 cc.



100% Italian
Loaf Volume 1880 cc.

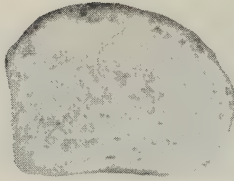


100% German
Loaf Volume 1930 cc.
BACK VIEW

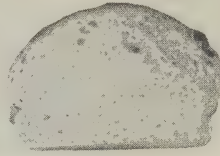


100% Australian
Loaf Volume 2180 cc.

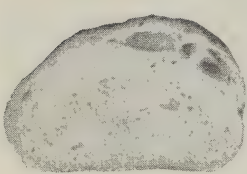
Plate 16.—Blends of Italian and Canadian



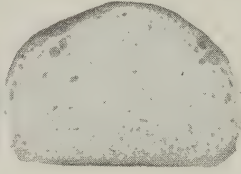
100% No. 1 Manitoba
Loaf volume 3000 cc.



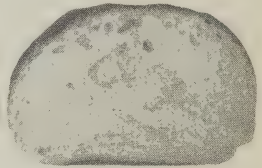
100% Italian
Loaf Volume 1880 cc.



85% Italian
15% No. 1 Manitoba
Loaf Volume 2100 cc.



75% Italian
25% No. 1 Manitoba
Loaf Volume 2360 cc.
FRONT VIEW

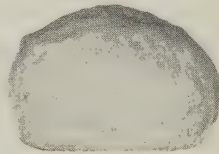


60% Italian
40% No. 1 Manitoba
Loaf Volume 2630 cc.

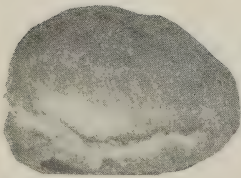
PLATE 17.—Blends of Italian and Canadian



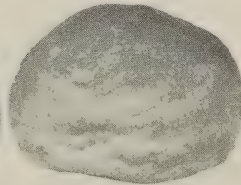
100% No. 1 Manitoba
Loaf Volume 3000 cc.



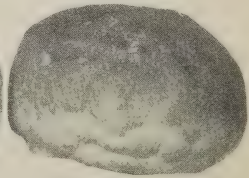
100% Italian
Loaf Volume 1880 cc.



85% Italian
15% No. 1 Manitoba
Loaf Volume 2100 cc.



75% Italian
25% No. 1 Manitoba
Loaf Volume 2360 cc.
BACK VIEW



60% Italian
40% No. 1 Manitoba
Loaf Volume 2630 cc.

Hearth loaves are a more exacting test of quality than pan loaves since any weakness in the dough will be shown up by a tendency to spread rather than to rise. The superiority of Canadian wheat is even more marked by this test than it is when pan loaves are baked. The dough stands up well and the volume is appreciably larger than that of any other wheat. In addition, the external and internal appearance of the Canadian loaf is superior. The blending tests with Italian wheat show a marked improvement as the percentage of Canadian wheat in the blend is increased.

This beneficial effect of the use of Manitoba wheats is not confined to the higher grades although, naturally, the improvement resulting from use of the lower grades is not so marked. The lower grades tend to give loaves with rather poorer texture and colour, particularly when the fermentation period is increased. The following results obtained in the Dominion Grain Research Laboratory illustrate this point:—

Flour Blend		Grade of Canadian Wheat Used	Loaf Volume		Texture	Appearance	General Baking Quality
Australian	Canadian						
Per Cent	Per Cent		Cu. Cm.	Per Cent			
SHORT FERMENTATION							
100	.....		2390	100	Very slightly open (7)	Fairly good...	Fair
60	40	1	2720	114	Good (8).....	Good.....	Good
60	40	4	2670	112	Very slightly open (7)	".....	"
60	40	5	2600	109	".....	".....	"
60	40	6	2690	113	".....	".....	"
60	40	feed	2520	105	Slightly open (6)....	.....	Fairly good
LONG FERMENTATION							
100	.....		2070	100	Slightly open (6)....	Poor.....	Fair
60	40	1	2710	131	Good (8).....	Good.....	Good
60	40	4	2680	129	Very slightly open (7)	".....	"
60	40	5	2560	124	".....	".....	Fairly good
60	40	6	2600	126	Slightly open (6)....	".....	"
60	40	feed	2320	112	Coarse (3).....	Fairly good...	Fair

8. FLOUR YIELD AND RELATED FACTORS

WEIGHT PER MEASURED BUSHEL

Canadian wheat excels in bread yield and baking quality, and these features alone are sufficient to justify giving it a prominent place in the system of blending. However, it is well to emphasize that Manitoba wheats, especially the higher grades, are highly satisfactory in other important respects. The weight per measured bushel is an almost universal index of value because of the indication which it gives of the probable yield of flour. The higher grades of Canadian wheat have a high weight per measured bushel. The following table was prepared from figures given by Kent-Jones in *Modern Cereal Chemistry* and by the British Ministry of Agriculture and Fisheries in the "Report on the Marketing of Wheat, Barley and Oats in England and Wales."

Wheat	Weight per Bushel	Wheat	Weight per Bushel
	Lbs.		Lbs.
Manitoba (Canadian).....	63-65	Barusso.....	60-65
Northern Spring.....	63-64	Australian.....	60-64
Hard Winter.....	60-63	Indian.....	58-64
Red Winter.....	60-63	Manchurian.....	58-62
Rosafe.....	60-64	English (10-year average).....	62

These figures show that the higher grade Manitobas are among the heaviest wheats in world commerce.

There is, of course, variation in weight between the different grades of Canadian wheat, and also in the same grade in different years. The following table, prepared from tests of the weights of many samples in each grade, each year, gives the average weight for each grade over the period 1926-29 inclusive; and as these years included a wide variety of weather conditions the figures should be fairly close to the general average.

WEIGHT PER BUSHEL OF CANADIAN WHEAT GRADES
(1926-1929 inclusive)

Grade	Weight per Bushel	Grade	Weight per Bushel
	Lbs.		Lbs.
Manitoba 1 Hard.....	66	Manitoba 4 Northern.....	61½
“ 1 Northern.....	64½	“ 5 wheat.....	60½
“ 2 “.....	63	“ 6 “.....	59
“ 3 “.....	62½		

MOISTURE CONTENT

The buyer can be assured of a reasonably low moisture content in Canadian wheat. By law, the moisture content of the straight grade can never exceed 14·5 per cent. Grain containing more moisture is graded “tough”. Since 14·5 per cent is the maximum allowable moisture content, the average is generally considerably below this figure. The following table, compiled from information given by Kent-Jones in his book on *Modern Cereal Chemistry*, gives the average moisture content of wheats from different countries as received in England:—

Wheat	Moisture	Wheat	Moisture
	Per cent		Per Cent
Manitoba (higher grades).....	10-11	Northern Spring.....	10-12
Manitoba (lower grades).....	11½-12½	Red Winter.....	11½
English.....	14½-16½	Pacific.....	10½
Australian.....	10	Hard Winter.....	11½
Indian.....	9	Plate.....	10½-12
Persian.....	9	Manchurian.....	12-13½

The average moisture content of the higher grade Canadian wheats compares very favourably with that of the other hard wheats shown in the table.

DOCKAGE

Canada limits, by government regulation, the amount of foreign material which may be present in export shipments of wheat. The elaborate system of inspection by which these regulations are enforced has been described. In buying Canadian wheat the importer has absolute assurance of its cleanness. He knows in advance that he is purchasing wheat and not dirt, weed seeds, or other grains, and he does not have to bear the expenditure of time and money required to put dirty wheat in condition for milling.

YIELD OF FLOUR

While low moisture, low dockage, and high weight per measured bushel are features to be desired in a parcel of wheat, they are, after all, only indications of the quality that the miller really wants to obtain—namely, the ability to give a high yield of flour. In this respect the Manitobas and Northern Spring excel all other kinds of hard wheat. Some of the soft wheats, of course, give higher yields.

The following table is compiled from Kent-Jones, *Modern Cereal Chemistry*.—

Wheat	Flour Yield	Wheat	Flour Yield
	Per cent		Per Cent
Manitobas (Canadian).....	72-75	Pacifics.....	73-76
Northern Spring.....	72-75	Indian.....	70-74
Hard Winter.....	72-74	Russian.....	68-72
Red Winter.....	about 74	Manchurian.....	70-72

The figures, given above, apply to the higher grades of Manitobas. It is evidence of the excellence of the Canadian grading system that the yield of flour decreases regularly as the grade is lowered. The following table, compiled from results obtained by the Dominion Grain Research Laboratory, gives the average yield of flour from each grade of wheat for the period 1926-1930 inclusive. It should be noted that a shorter extraction was used in these tests, and the figures are therefore not directly comparable with those in the preceding table.

Grade	Flour Yield	Grade	Flour Yield
	Per Cent		Per Cent
No. 1 Manitoba Hard.....	71.4	No. 4 Manitoba Northern.....	67.0
No. 1 " Northern.....	70.5	No. 5 Wheat.....	65.5
No. 2 " ".....	69.8	No. 6 ".....	62.0
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